

REMARKS

Initially, Applicants would like to express appreciation to the Examiner for the detailed Final Official Action provided.

Claims 1-22 are currently pending. Applicants respectfully request reconsideration of the outstanding rejections and allowance of claims 1-22 in the present application. Such action is respectfully requested and is now believed to be appropriate and proper.

Claims 1-4, 6-9, 11-16, 18, 19, 21, and 22 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over TONG et al. (U.S. Patent No. 6,902,987).

The Examiner has noted that TONG et al. does not “expressly” disclose that peaks on one bonding surface shear the bonding inhibitor layer on the other bonding surface. The Examiner contends that “since Tong clearly teaches that the two bonding surfaces are bonded together, it would have been obvious to one skilled in the art that the peaks must necessarily cut through the oxide on the opposing bonding surface in order to ensure a strong bond”.

However, Applicants note that TONG et al. fails to teach or suggest the subject matter claimed in independent claims 1, 13, and 22.

Applicants’ claimed invention provides a method of and apparatus for bonding surfaces including a surface roughness control step in which the surface of the bump electrodes 1b is processed to have a predetermined roughness. Subsequently, the electronic component 1 is held by a bonding tool 6, so that the bump electrodes 1b and the electrode lands 2a are aligned, ultraviolet light is projected onto the component 1 and onto the substrate 2 so as to remove bonding inhibitor substances that have adhered to the bump electrodes 1b and electrode lands 2a after the initial cleaning, and the bump electrodes 1b and the electrode lands 2a are bonded together.

In particular, the surface roughness control step includes lowering a rough surface plate 3 toward the bump electrodes 1b of the electronic component 1, and applying a predetermined pressure, whereby an uneven surface profile is created on the surface of the bump electrodes 1b. The bonding surface is thus provided with a predetermined roughness in which the bonding surface has a profile including fine peaks formed at close intervals. In particular, the peak height is in the range of 2 to 5 μm . See page 18, line 16. The peak height of the present invention provides a surface roughness that will shear a layer of bonding inhibitor substance from the other bonding surface.

Then, by pressing the bonding surface with fine peaks against the other of the bonding surfaces, the fine peaks shear a layer of bonding inhibitor substance from the other bonding surface, ensuring a strong bond. Accordingly, the joint strength quality is controlled in the mass production process.

The TONG et al. patent discloses a bonding method including surface treating in which the surface is planarized and smoothed, a bonding inhibitor substance is removed, and the objects are bonded. Therefore, in the TONG et al. method, the surface roughness treatment provides a *smoother* surface. The TONG et al. method does not include a surface roughness treatment including forming peaks on the surface and making the surface *less smooth*.

In this regard, TONG et al. teaches that peak height is within the range of 0.1 to 3 nm. The value of the peak height may vary in an amount from some angstroms to some nanometers, depending on the material. As described above, the peak height of the present invention is within the range of from 2 to 5 μm .

Applicants respectfully submit that the peaks of TONG et al. are too small to break the oxide film when bonding is performed. In this regard, it is noted that the peaks of 0.1 to 3 nm (of TONG et

al.) are on the order of *atoms*. This peak size is not large enough to break the oxide film. Thus, contrary to the Examiner's assertions, the peaks of TONG et al. are too small to break the oxide film.

Additionally, in the TONG et al. method, the bonding is produced by a chemical process. However, in the present invention, the bonding is produced by the *combination* of a physical process (breaking the oxide film with the rough surface peaks), and a chemical process (activators).

Therefore, TONG et al. fails to teach or suggest a method and apparatus including surface-treating by providing a bonding surface with a predetermined roughness including fine peaks formed at close intervals, and removing a bonding inhibitor substance from the bonding surfaces by pressing the fine peaks against the other of the bonding surfaces so that the fine peaks shear a layer of bonding inhibitor substance from the other bonding surface.

The Examiner has concluded that "since Tong clearly teaches that the two bonding surfaces are bonded together, it would have been obvious to one skilled in the art that the peaks must necessarily cut through the oxide on the opposing bonding surface in order to ensure a strong bond". However, Applicants submit that nothing in the applied prior art teaches or suggests the claimed combination including surface-treating to produce a predetermined roughness including fine peaks formed at close intervals, and removing a bonding inhibitor substance from the bonding surfaces by pressing the fine peaks formed at close intervals against the other of the bonding surfaces so that the fine peaks shear a layer of bonding inhibitor substance from the other of the bonding surfaces.

In particular, Applicants submit that the peaks of TONG et al. would *not* necessarily cut through the oxide film. In this regard, the Examiner has proffered no evidence that the peaks of TONG et al. would cut through the oxide film, nor has the Examiner provided any explanation at all

as to why the TONG et al. peaks would necessarily shear the oxide film. The Examiner has merely made the unsupported statement that the peaks of TONG et al. would necessarily shear the film.

Moreover, it is respectfully submitted that the present application provides evidence that the peaks of TONG et al. *would not shear* the oxide film. In this regard, it is noted that that peaks of the present invention are in the range of from 2 to 5 μm . The peaks of TONG et al. are in the range of from 0.1 to 3 nm. Since the nanometers are on the order of *atoms*, the peaks of TONG et al. are not big enough or strong enough in order to shear the oxide film, as contended by the Examiner.

Accordingly, contrary to the Examiner's assertions, the TONG et al. surface will not shear the oxide film.

Further, since the TONG et al. rough surface would not shear the film, it also would *not* (and could not) have been obvious that the TONG et al. rough surface would shear the film.

Further, regarding claim 13, the Examiner has contended that a recitation in an apparatus claim of the purpose of the apparatus or of a workpiece in the apparatus is not significant in determining patentability of a claimed apparatus. However, it is respectfully submitted that these contentions of the Examiner are misplaced. In this regard, it is noted that claim 13 sets forth an apparatus including, *inter alia*, "a surface treater that controls at least one bonding surface to have a predetermined roughness in which the bonding surface has a profile including fine peaks formed at close intervals". Clearly, then, claim 13 sets forth that "a surface treater" is an element of the apparatus. Further, as set forth the surface treater "controls at least one bonding surface to have a predetermined roughness" and "including fine peaks formed at close intervals". Thus, the surface treater is an element of the apparatus, and the surface treater controls a bonding surface. Therefore, the claim sets forth an element of the device and the function of that element. Clearly, a positively

recited element and its function do not rely on the workpiece or the purpose of the apparatus. Thus, it is respectfully submitted that the elements of the apparatus are clearly and positively recited in the apparatus claim, and that all claimed elements are significant in determining patentability. Further, it is respectfully submitted that, even assuming, arguendo, that it is proper to deny patentable significance to the purpose of an apparatus in an apparatus claim, claim 13 does not set forth the purpose as contended by the Examiner, and all claimed elements must properly be given patentable significance.

Accordingly, Applicants submit that a factual basis for the rejection has not been established and thus a prima facie case of obviousness has not been established, and that rejection of claims 1, 13, and 22 under 35 U.S.C. § 103(a) over TONG et al. can only result from a review of Applicants' disclosure and the application of impermissible hindsight. Accordingly, the rejection of claims 1, 13, and 22 under 35 U.S.C. § 103(a) over TONG et al. is improper for all the above reasons and withdrawal thereof is respectfully requested.

Applicants submit that dependent claims 2-4, 6-9, 11, 12, 18, 19, and 21, which are at least patentable due to their dependency from claims 1 and 13 for the reasons noted above, recite additional features of the invention and are also separately patentable over the prior art of record based on the additionally recited features.

Claims 5 and 17 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over TONG et al. in view of HORI et al. (U.S. Patent Appl. Pub. No. 2004/0105155).

Applicants note that TONG et al. fails to teach or suggest the subject matter claimed as set forth in independent claims 1 and 13, as described above. Further, HORI et al. fails to cure these deficiencies. In this regard, while HORI et al. teaches the use of a tool to provide an uneven surface

profile, HORI et al. still fails to teach or suggest surface-treating with a bonding surface including shearing a layer of bonding inhibitor substance by pressing the fine peaks against the other of the bonding surfaces. Thus, for at least these reasons, even if the teachings of TONG et al. and HORI et al. were combined, as suggested by the Examiner, the claimed combination would not result. Moreover, there is nothing in the cited prior art that would lead one of ordinary skill in the art to make the modification suggested by the Examiner in the rejection of claims 5 and 17 under 35 U.S.C. § 103(a) over TONG et al. in view of HORI et al. Thus, the only reason to combine the teachings of TONG et al. and HORI et al. results from a review of Applicants' disclosure and the application of impermissible hindsight. Accordingly, the rejection of claims 5 and 17 under 35 U.S.C. § 103(a) over TONG et al. in view of HORI et al. is improper for all the above reasons and withdrawal thereof is respectfully requested.

Claims 10 and 20 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over TONG et al. in view of KUB et al. (U.S. Patent No. 6,153,495).

Applicants note that TONG et al. fails to teach or suggest the subject matter claimed as set forth in independent claims 1 and 13, as described above. Further, KUB et al. fails to cure these deficiencies. In this regard, while KUB et al. teaches the use of ultraviolet irradiation for surface treatment, KUB et al. still fails to teach or suggest surface-treating with a bonding surface including shearing a layer of bonding inhibitor substance by pressing the fine peaks against the other of the bonding surfaces. Thus, for at least these reasons, even if the teachings of TONG et al. and KUB et al. were combined, as suggested by the Examiner, the claimed combination would not result. Moreover, there is nothing in the cited prior art that would lead one of ordinary skill in the art to make the modification suggested by the Examiner in the rejection of claims 10 and 20 under 35

U.S.C. § 103(a) over TONG et al. in view of KUB et al. Thus, the only reason to combine the teachings of TONG et al. and KUB et al. results from a review of Applicants' disclosure and the application of impermissible hindsight. Accordingly, the rejection of claims 10 and 20 under 35 U.S.C. § 103(a) over TONG et al. in view of KUB et al. is improper for all the above reasons and withdrawal thereof is respectfully requested.

Accordingly, Applicants respectfully request reconsideration and withdrawal of the rejections, and an early indication of the allowance of claims 1-22.

SUMMARY AND CONCLUSION

In view of the foregoing, it is submitted that the present response is proper and that none of the references of record, considered alone or in any proper combination thereof, anticipate or render obvious Applicants' invention as recited in claims 1-22. The applied references of record have been discussed and distinguished, while significant claimed features of the present invention have been pointed out.

Accordingly, consideration of the present response, reconsideration of the outstanding Final Official Action, and allowance of all of the claims in the present application are respectfully requested and now believed to be appropriate.

Applicants have made a sincere effort to place the present application in condition for allowance and believe that they have now done so.

Should the Examiner have any questions, the Examiner is invited to contact the undersigned at the below-listed telephone number.

Respectfully submitted,
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